

The Environmental Challenge: Unstructured Roads

1

Absence of Defined Lanes: Traffic flows organically rather than following marked lanes, leading to "Implicit Negotiation" between drivers.

2

Heterogeneous Traffic Mix: High diversity of agents (Rickshaws, CNGs, Bikes, Pedestrians) sharing the same lane

3

High Density Occlusion:
Frequent visual obstruction caused by large vehicles.



The Behavioral Challenge: Ambiguity in Decision Making

1

Implicit Negotiation: Right-of-way is determined by eye contact, horn usage, and aggressive maneuvering rather than traffic signals or rules.

2

Predictive Uncertainty: Lack of lane discipline makes predicting the trajectory of surrounding vehicles difficult.

3

Context-Dependent Risk: Risks vary rapidly based on road surface (potholes) and congestion levels

Action Frequency Distribution

Corpus Statistics

- Total videos: 11
- Total Duration: 218min
- Event Categories: 19
- Total Event Frequency: 184

1

High-Frequency Actions

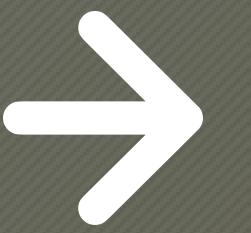
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Moderate-Frequency Actions

3

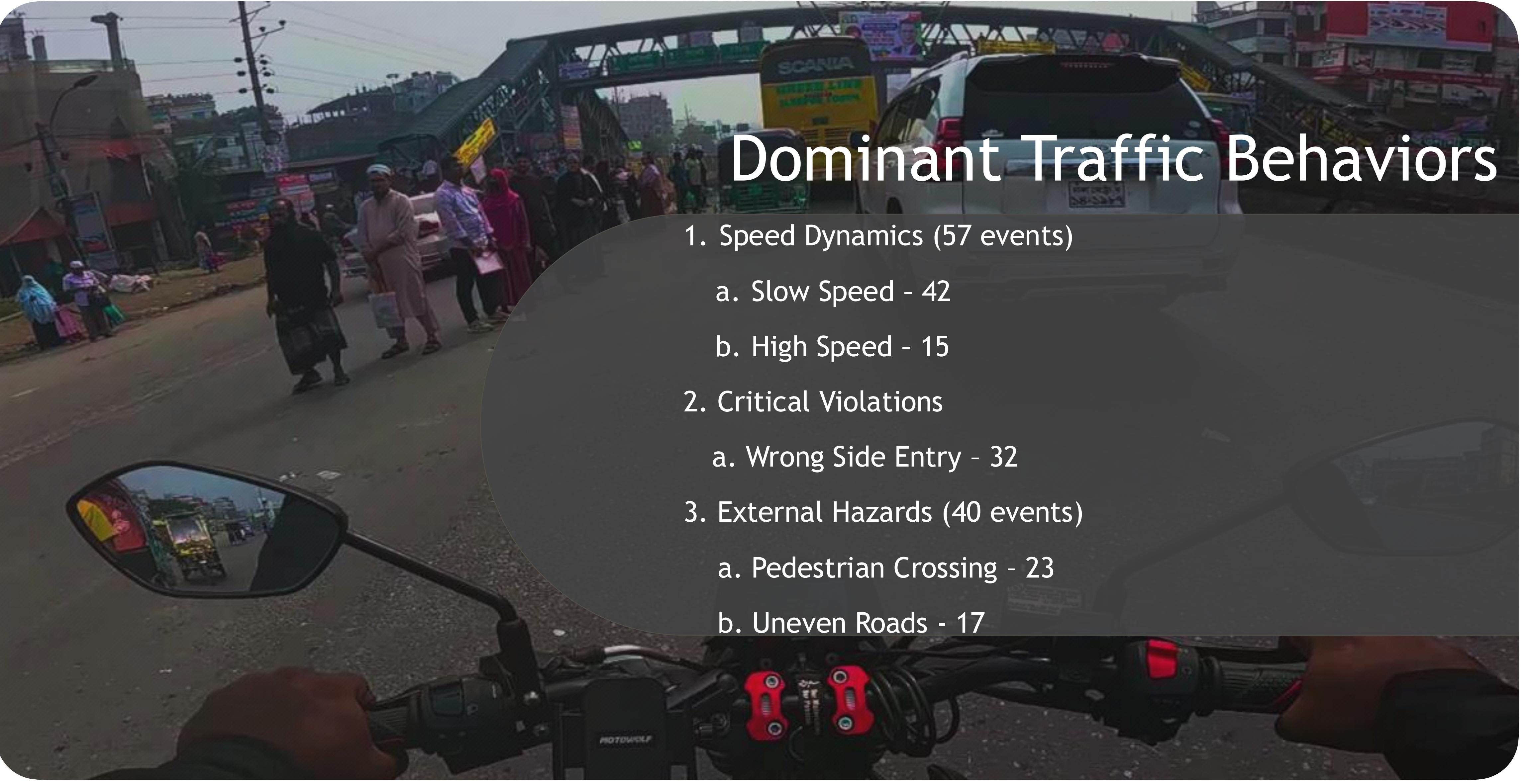
Low-Frequency Actions





High-Frequency Actions

Total Events Observed: 114



Dominant Traffic Behaviors

1. Speed Dynamics (57 events)
 - a. Slow Speed - 42
 - b. High Speed - 15
2. Critical Violations
 - a. Wrong Side Entry - 32
3. External Hazards (40 events)
 - a. Pedestrian Crossing - 23
 - b. Uneven Roads - 17

Speed Dynamics - Slow Speed

Analysis of environmental factors dictating Ego-Vehicle velocity

- DYNAMIC OBSTACLES (27)

- Front Vehicle Interaction: 16

- Pedestrians Crossing: 5

- Traffic Jam / Congestion: 3

- Animals: 3

- STATIC INFRASTRUCTURE (15)

- Speed Breakers: 15



Speed Dynamics - High Speed

Analysis of environmental factors
dictating Ego-Vehicle velocity

- CLEAR ROAD
- OBSERVATION

Average sustained speeds of 55-75 km/h
Over Speed than Speed Sign



Wrong Side Vehicle Entry

Wrong-side driving is a common "unstructured" behavior used to bypass congestion or avoid U-turns.

Total Incidents: 32

Agile/Light Vehicles(90%)

- High acceleration, easy to maneuver in wrong lanes
- **Motorbikes:** 8
- **E-Rickshaws (TomTom):** 7
- **CNGs & Rickshaws:** 12
- **Bicycles:** 2

Heavy Vehicles (10%)

- *Harder to maneuver, rarely violate lanes.*
- **Cars/Micros:** 2
- **Trucks:** 1

Wrong Side Vehicle Entry: Clips



Pedestrian Crossing Dynamics: Intent vs. Ambiguity

Signaling (Explicit Intent)

- Hand gestures to halt traffic flow

Non-Signaling (Implicit Ambiguity)

- Creates a conflict without intent

Two distinct patterns of mid-block crossing on unstructured roads.

Pedestrian Crossing Dynamics: Clips



Surface Analysis

Breakdown of Environmental Speed Constraints

SURFACE GEOMETRY

Potholes / Holes: 6

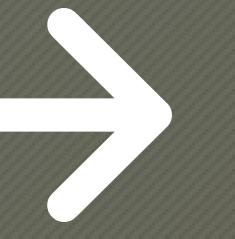
Broken Roads: 3

General Unevenness: 2

SURFACE CONDITION

Wet Surface: 5





Moderate-Frequency Actions

Total Events Observed: 48

Interaction Dynamics & Ambiguity

Category 1: Behavioral Uncertainty (16 Events)

- *The "Will they/Won't they" problem.*
- **Turning Actions:** 7 (*Vehicle intended to turn & turned*)
- **Aborted Crossings (Vehicle):** 4 (*Vehicle tried to cross but stopped*)
- **Aborted Crossings (Pedestrian):** 5 (*Pedestrian stepped out but didn't cross*)

Interaction Dynamics & Ambiguity

Category 2: Lateral Maneuvers (21 Events)

- *Objects moving sideways across the frame.*
- Blind Spot Intrusion: 8
- Overtaking: 7
- Lane Changes: 6

Interaction Dynamics & Ambiguity

Category 3: Obstacles (11 Events)

- Animals: 4
- Physical Obstructions: 4
- Toll Box Stops: 3

Blind Spot Movement

Motorized Intrusions

- Peripheral Turn Entry - 1
- Cut-In Maneuver - 2

NMV (Non-Motorized Vehicle) Intrusion

- Bi-Cycle Crossing - 1
- Rickshaw Crossing - 4

VRU (Vulnerable Road User) Appearance

- Pedestrian Crossing - 1



Vehicle intended to turn and turned

Total Validated Turns: 7 Events

1. Agile Maneuvers (Sharp Turning Radius)

- *Challenge: Sudden angular changes with minimal signaling.*
- **Vehicles:** Bike (1), E-Rickshaw (1), Paddle Rickshaw (1).

2. Wide-Arc Maneuvers (Large Turning Radius)

- *Challenge: Vehicle occupies multiple lanes during the turn (Occlusion).*
- **Heavy:** Bus (1), Truck (1).
- **Light:** Microbus (1), Mini Pickup (1).



Behavioral Ambiguity: Aborted Turns

Total Aborted Maneuvers: 4 Events

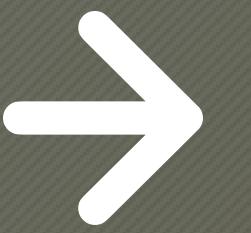
1. Non-Motorized Vehicles (NMV): 3

- Rickshaws: 2.
- Bi-Cycle: 1

2. Motorized Vehicles: 1

- CNG: 1





Low-Frequency Actions

Total Events Observed: 7

Critical Anomalies & Edge Cases

Category 1: Safety-Critical Events (3 Events)

Sudden Stops (2): Front vehicle performs emergency braking.

Accident (1): A collision or near-miss event.

Category 2: Rare Regulatory Elements (2 Events)

Traffic Police Signal (1)

Speed Sign (1)

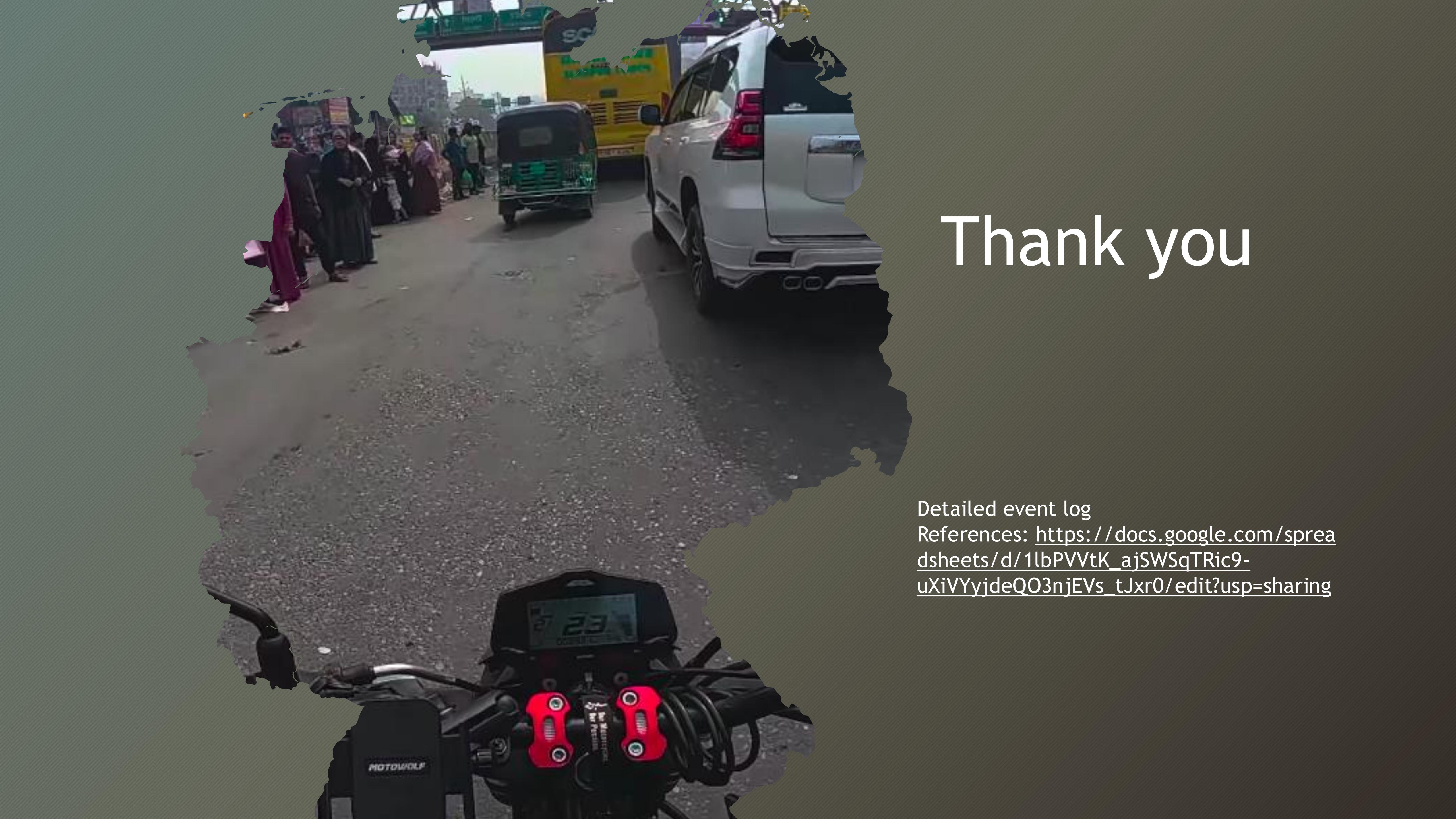
Category 3: Behavioral Noise (2 Events)

Vehicle signaled but didn't turn.

Vehicle attempted to cross and succeeded.

Critical Anomalies & Edge Cases - Clips





Thank you

Detailed event log

References: https://docs.google.com/spreadsheets/d/1lbPVVtK_ajSWSqTRic9-uXiVYyjdeQO3njEVs_tJxr0/edit?usp=sharing